



# Contract and Custom: Two Registers of Didactical Interactions

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# Contract and Custom: Two Registers of Didactical Interactions<sup>1</sup>

Nicolas Balacheff

Translated and edited<sup>2</sup> by Patricio Herbst

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## *A Social Problématique*

Research in *didactique* of mathematics<sup>3</sup> is founded on the constructivist thesis from Piaget's genetic epistemology: "The hypothesis that the subject explores actively his or her environment, and actively participates in the creation of space, time, and causality." (Inhelder & Caprona, 1985, p. 8). Likewise the subject, who for us is the student, actively participates in the construction of his mathematical knowings.<sup>4</sup>

These psychological bases are, however, insufficient for at least two reasons. On the one hand because (the acquisition of) mathematics<sup>5</sup> requires the development of situations that are specific to the nature and functioning of the discipline. It is nowadays a truism to say that it is impossible to expect the child to reconstruct mathematics spontaneously from free interactions with his or her environment: "There is no natural method for the teaching of mathematics" (Brousseau, 1972). The development of those learning situations requires above all else an epistemological analysis in order to determine the suitable conditions for the constitution of the meanings associated to a given mathematical notion.

On the other hand, the psychological bases are insufficient because the teaching of mathematics has a social dimension that is revealed through two sorts of constraints, one specific to the knowledge-to-be-learned itself and the other related to the organization of the knowledge taught:

- Mathematical knowledge has a very strong social status. Students must acquire items of knowledge<sup>6</sup> which are already known (and recognized as such) by the society at large or by some of its divisions, and which are being used by these groups. This constraint is particularly obvious when one considers the learning of notations and other means of representation that are specific to a given item of mathematical knowledge.
- Even when it is agreed that what is at issue is the learning of each individual student, the teacher also has the responsibility of ensuring the homogeneity of the

construction of the items of knowledge and their coherence at the level of the class in general. Without that homogeneity, the didactical<sup>7</sup> functioning of the class would be impossible. As the constructivist hypothesis entails that recourse to the authoritarian imposition of a given item of knowledge is impossible, such homogenization can only be produced in social interaction. Brousseau (1972, 1981) has described the fundamental forms that this social interaction can take in the teaching of mathematics within the framework of the theory of didactic situations.<sup>8</sup>

These two social dimensions place the teacher in a very special position, at the junction of the system of societal knowledge and the system of the items of knowledge constructed in the classroom. And he or she has the responsibility of ensuring the adequacy of the second system in relation to the first. Moreover, the teacher has the responsibility of ensuring that the functioning of the knowledge and the intellectual productions of individuals are regulated; the teacher can do that either by direct intervention or by means of using some specific learning situations.

This article addresses the study of phenomena related to those social constraints on the didactic functioning in the context of my research on proof, and in particular on mathematical proof. Elsewhere I have reported on a study about the characterization of situations of validation. I offered an analysis of the relations between the characteristics of these situations and the nature of the processes of proof used by students (Balacheff, 1987).<sup>9</sup> These analyses had essentially addressed situations of validation largely isolated from the teacher, that is to say *adidactical situations*<sup>10</sup> in the sense of Brousseau (1984). In this paper I draw on the results of an experimental study (Balacheff, 1988) to examine the didactic constraints attached to the social characteristics of didactic situations, particularly the problem of the nature and means of their regulation.

## *Genesis of a Conjecture and Devolution of the Problem of Proving It*

In order to illustrate my proposal, I have chosen a portion of an experimental study that I conducted with 7<sup>th</sup> grade students. The study dealt with the students' construction of the conjecture that the sum of the angles of a triangle is 180

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degrees and the *devolution*<sup>11</sup> of the problem of proving this conjecture. The *devolution of the problem* not only means that each student makes it his or her own problem, but also that the class as a whole recognizes the problem of proving the conjecture and thereby adopts a collective responsibility. This socialization is a necessary condition for the existence of a proving debate as characteristic of a type of didactical situation; it is the classroom community the one that is engaged.<sup>12</sup> Additionally, what is understood as *conjecture* in this paper is more than a mere speculation or a statement that is only plausible: The truth of the statement must be perceived by the class as sufficiently interesting and problematic that a process of ascertaining it is felt to be in order by the class.

The cornerstone for the construction of this sequence is the student's conception that all measures associated with a triangle increase as the size of the triangle increases. Such a conception is known to be common among French seventh grade students. The origin of this conception can probably be found within the practices of measuring area or perimeter, and actually holds for the usual geometric forms in general. The conception leads to the following theorem-in-action:<sup>13</sup> "The larger a triangle, the bigger is the sum of its angles." Encountering a contradiction to this theorem-in-action will become the source for the conjecture to be constructed.<sup>14</sup>

The teacher is not to indicate the objective of the sequence of activities at the beginning of their implementation: If that were done, it would obviously run the risk of losing the conjectural character of the target proposition. Therefore, in designing the sequence it was necessary for us to find conditions under which the measure of the angles of a triangle and the manipulation of those numbers could be introduced without rendering it necessary to make explicit the learning objective that was being sought. At the grade level where the experience was to take place—the French equivalent to 7<sup>th</sup> grade—the lessons on angles (as prescribed in the curriculum) constituted one natural frame. Activities that involved measuring angles in a triangle could be easily introduced as a novelty because it is normal for teachers to update situations by making them a little bit more complex or changing the context. It did not seem necessary to justify the introduction of the triangle in any other way.

Within this frame, the first activity would require the students to trace a triangle, measure its angles, and add up the results obtained. The teacher would record the sums from the class and draw a histogram on the board. Up to this point all proposed results would be acceptable and should be recorded by the teacher without noting anything special about the differences. These differences do not have a particular meaning: For example, they may appear normal for students due to the fact that the sums correspond to different triangles.

In order to differentiate among the variety of results obtained between those that relate to the uncertainty of measurement and those that relate to students' erroneous conceptions, the whole class would then need to measure the angles of the same given triangle. Student conceptions of the relation between the size of a triangle and the sum of the measures of its angles must also be called into play.

Thus, in the second activity each student would receive an identical copy of a given triangle (without special geometric characteristics), but sufficiently large in comparison with the triangles that students usually trace in order to engage the expected conceptions. The second activity would ask students to predict the sum of the measures of the angles of this triangle before determining this number. Once each student has determined the sum of the actual measurements, the teacher would record the sums that each student has obtained and note them in a histogram on the board. These results are compared with the predictions and each student is asked to comment on the comparison between his prediction and his result; then the class is asked to comment on the histogram. The requirement that each student comment on the comparison between his or her prediction and the result obtained is intended to underscore possible differences between these two numbers. The requirement that the class comment on the histogram aims at making explicit the necessity that all the students should have obtained the same measurements for the same triangle.<sup>15</sup> The differences that would arise would therefore be explained by the errors associated with measurement; errors related to the instruments or the practices of measurement.

The situation thus arising would have the characteristics of a *situation of action*.<sup>16</sup> It would permit the engagement of conceptions that serve as models of action or of decision in the succeeding activities, and hence it would support the construction of the conjecture. Nevertheless, for the time being, any difference noted between prediction and measurements would not be necessarily seen as problematic: It could legitimately be seen as contingent, since it is related to a particular choice of triangles.

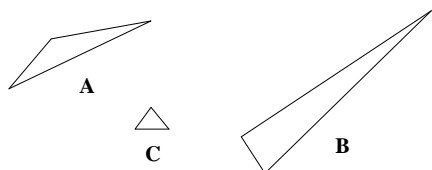
Thus far in the development of the sequence only the conditions for the genesis of the conjecture would have been achieved:

- student conceptions that would lead to the conjecture would have been activated and the milieu within which this genesis takes place would have been constituted;
- the uncertainty of the measurements would have been noted, making possible to view knowing the sum of the angles of a given triangle as problematic. The disqualification of measurement as a way to determine this sum would legitimize the requirement of *intellectual proofs*<sup>17</sup> for the expected conjecture.

The third activity aims at enabling the formulation of the problem of the invariance of the sum of the measures of the angles of a triangle; eventually it aims at enabling the emergence of the conjecture that states that this sum is equal to 180 degrees.

To bring about the recognition of this invariance, it would be necessary that the students perform actual measurements and calculations for several triangles. But these experiences would not have any special meaning unless the students effectively engage their conceptions. The conjecture and the requirement of proving it should arise at the individual and at the classroom levels from a conflict between two sets of conceptions: On the one hand those that assert that the sum of the angles of a triangle depends on the shape of the triangle, and on the other hand those that support the empirical results of measurement that place this sum in the neighborhood of 180 degrees.

Three triangles, like those shown in Figure 1, are chosen for this activity, under the hypothesis that they would enhance the probability of a conflict between conceptions. On the one hand, triangles A and B are of sufficiently uncommon shapes so that one could expect that which way to predict the sums of the measures of their angles would not be obvious. Rather, it would be expected that these triangles would lead the students to nontrivial reasoning that would engage their conceptions. On the other hand, triangle C is notably smaller than the other triangles that students are likely to have experienced so far, and hence it would probably promote predictions that the sum is much less than 180 degrees.



To support the effective engagement of conceptions and the emergence of cognitive conflict, the students' activity should be organized in teams. Each team should receive a copy of the three triangles and would be required to agree on an *a priori* evaluation of the sum of the angles for each triangle. The requirement of this agreed-upon prediction for the group would satisfy the theoretical conditions of a *situation of decision* in which the confrontation of viewpoints is supposed to lead to the proposal of explanations based on the conceptions of each of the members. When this activity is complete the teacher would be expected to collect and record the results obtained in a histogram drawn on the chalkboard. The collection of results is the opportunity for a public discussion of contradictions between the results and the predictions. This discussion is expected to underline possible contradictions and encourage the spelling out of the conceptions.

Immediately following this discussion of the predictions and results, the teacher would ask students whether, after examining the three histograms and in the light of the comments that have been offered, they have any particular observations to make. Such a question might seem too open, but the requirement that each triangle must have a precise value for the sum of the magnitudes of its angles—which is implicit in the question—makes the question meaningful. The problem of knowing this precise value must now be posed.<sup>18</sup>

My hypothesis is that the robustness of the initial conceptions ensures that both positions in favor and against the envisioned conjecture would have actual supporters in the classroom. The students, in that case, would be in a situation of validation, where they are bound to produce one or more proofs<sup>19</sup> of the conjecture or else refute it.

The design of the described sequence of activities is, therefore, based on setting up a certain type of social interaction that, eventually, would require the students to take on *responsibility for truth* and, hence, to play a game in which the teacher is to some extent disengaged from the knowings. This type of social interaction can be described by a set of rules—almost always implicit—that organizes the exchanges among the students and between students and teacher so as to permit the knowings to function in a certain form—in this case, the form in which the knowings function would be allowing the construction of a conjecture. This set of rules constitutes the didactical contract in the sense of Brousseau (1981).<sup>20</sup>

### ***Custom of a Mathematics Classroom and Didactical Contract***

#### *The pertinence of a concept of custom for didactical analysis*

I have observed the implementation of the sequence of activities on the sum of the angles of a triangle in many 7<sup>th</sup> grade classes. Two of these were videotaped (in March 1983 and in January 1984) and I have analyzed them in detail relying on the complete transcriptions of the dialogues (Balacheff, 1988). The two videotaped classes—referred as D and E—present a particularly striking contrast of practices. Important differences between the two classes were noted in the negotiation of the didactical contract specific to the situation: In class E this negotiation faced an obstacle to be described below which I had previously interpreted as resulting from the initial “standing” contract for that class.

The differences between the classes were essentially noted with respect to some rules of social functioning that are described in the sequel. These rules concerned

mathematical activity and had been made explicit in class E but not in class D. In fact, due to their very general legislative character, those rules no longer appear to me as belonging to the didactical contract but to a deeper and more enduring order. The distinction between customary society and legal society seemed to be a good model to account for and analyze the difficulties encountered in the negotiation of a didactical contract in class E and consequently the difficulties associated with the devolution of the problem.

The classroom is a society of customs. *Custom* is understood here as a set of obligatory practices (Carbonnier, 1971) established as such by their use, and which, in the majority of the cases, is established implicitly. *Custom* regulates the way in which the social group expects to establish relationships and interactions among its members and, therefore, it is initially characterized as a product of social practices. Within this framework, some sociologists of law consider the explicit formulation of rules as one of the mechanisms that allow a society of customs to become a legal society:

What makes [customary and legal societies] different is a technical fact: As we have seen, while custom is spontaneous and 'unconscious,' law emanates from a specialized organism and through a procedure that within our present societies receives the name of *promulgation*. (Levy-Bruhl, 1964, p. 55, my italics)

Certain properties of the didactical contract (Chevallard, 1983, p. 11) can be reformulated *mutatis mutandis* so as to characterize custom. For example, in the same way as the didactical contract becomes visible when it is broken, "one only realizes the existence [of custom] when it produces its effects" (Levy-Bruhl, 1964, p. 44).

However, the concept of contract as it has been described in the literature up to now is insufficient to account for the complete set of social phenomena that regulate the functioning of knowledge in a class. For example, the envisioned sequence of devolutions to the students and of resummptions by the teacher of the "responsibility for truth" in the case of the sum of the angles of a triangle, suggests a sequence of contracts that could imply an instability that is not confirmed in the observation of actual classes. Moreover, the *problématique* of the contract leads one to ask about its origin, to identify the parts that hold the contract, to determine the place and moment of its negotiation, to estimate its duration. To the question "when ... who... has established the contract ... instituted the rules?" Chevallard responds: "It is always already done and gone. (...) One subscribes to the contract when one enters into the kind of social relationships that the contract regulates" (1983, p. 11). The concept of custom is much better adapted to account for the modes of regulation of the social functioning in the class and at the same time it may circumscribe the domain of validity of the concept of

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didactical contract. It may also be possible that this differentiation between contract (a notion that I see more as having a local character and being a key element in the process of devolution) and custom (a notion that I see as regulating the social functioning of a given class across time) will permit to do away with all the "misfortunes of the concept of didactical contract" (Brousseau, 1984, p. 45).

Insofar as it is *produced in and by practice*, the custom of a mathematics class is specific to the knowledge taught in that class. This is clear, for example, with respect to what constitutes a proof or the definition of "true." I refer to "*a* class" and not to "*the* class" because custom is specific to each level of schooling. Thus, it is likely that the custom of the 7<sup>th</sup> grade class will be different from that of the 8<sup>th</sup> grade class. In France, mathematical proof is among the practices of the 8<sup>th</sup> grade class. But before becoming a mathematical object or a mathematical tool, mathematical proof is, for a 7<sup>th</sup> grade student, this new thing that will have to be done and to which the student will have to be initiated. This leads us not so much to pose the question of the origins of the custom as much as that of the initiation of students to the custom of the class in which they enter. An initiation into a sort of system of new "rights and duties [of subscribers to an agreement] within the frame of a shared reference" (Chevallard, 1983, p. 11).

In contrast, the didactical contract has a local character. It is negotiated for a particular task that requires the rules for the social functioning of the class to be defined locally and in a new way. For example, the devolution to the class of the responsibility for truth in the solution of a problem where the student agrees to play a game with restrictions or artificial characteristics that are nevertheless necessary for a certain functioning of the knowledge (like the situations of communication aforementioned or the impossibility of using some material means). Custom matters at the moment of negotiation of the didactical contract, in particular in determining what is negotiable and what is not. When the contract vanishes, the class comes back to its usual custom.

### *Agreed-Upon Response and Knowing*

In the implementation of the sequence described above, I observed with some regularity (across the various 7<sup>th</sup> grade classes) the emergence of a norm, from the moment of the analysis of the first measurements throughout the first activity. This norm excludes measurements that lie far outside the interval  $[170^\circ, 190^\circ]$ , so that the announcements of measurements such as  $231^\circ$  would provoke the amusement of the class in general. The emergence of a norm is confirmed by the increase of predictions of  $180^\circ$  in the second activity, and moreover by the immense majority of effected calculations that happen to yield  $180^\circ$ . This last indicator is the most relevant because it entails that there

had been a correction “towards 180°” of results initially obtained.<sup>21</sup> This does not mean, however, that the students had acquired the idea that the sum of the angles of any triangle would be 180°. For example, in class D, 21 students from a total of 25 “obtained” 180° for the proposed triangle, but at the time of the third activity and after discussion, some of them (12 students) stuck to a different value for one of the three triangles. The conformism that is at the origin of the first responses is essentially fragile because it is reached under the initial imposition of producing “agreed-upon” responses or assumed so by the students. But conformism by itself cannot generate true knowings and thus it does not allow the student to face a situation outside the frame in which the agreement has been reached.

The emergence of a norm, phenomenon that was observed in all classes, is probably not avoidable. The source of the students’ identification of “acceptable” responses after the first activity is most likely the effect of an expectation that every classroom activity entails the existence of expected behaviors or responses, reinforced by “an ardent and unshakable desire to be in accord with the group” which Watzlawick (1987, p. 88-95) has shown leads to conformist behaviors.

I suggest that principles of this level of generality (such as the injunction to find an agreed-upon solution so as to be in accord with the group) which are involved in regulating the activities of the class (as seen in the correction of measures toward 180 degrees) should be considered within the domain of the custom. Accordingly, I see custom operating in the way that Chevallard reserved for the contract, i. e., custom “operates as a code, a generating principle for some behaviors that are by the same token defined as orthodox” (Chevallard, 1983, p. 11).

### *An Impossible Legal Society*

One of the main misfortunes of the notion of didactical contract as a fundamental concept for didactique seems to be the idea that one should be able to make explicit as thoroughly as possible a “good contract.” Such a “good contract” would be made explicit to the students as defining what is accepted with regard to their rights and duties, “a sort of permanent object that should have been agreed upon” (Brousseau, 1984). But as Brousseau remarks, the notion of didactical contract has nothing to do with that idea of a “good contract”, because the didactical contract is always (of necessity) invisible (p. 45). Everything happens as if there was a contract, but that contract can never be agreed upon and whenever it is effectively agreed upon, it cannot be enforced.

The model of custom should allow one to understand and explain what could appear to be a paradox of the contract: the necessary implicitness of its reality and the

necessity of its failing when spelled out. This failure highlights the fact that the spelling out of the rules changes the nature of the social interactions in the classroom. Just as occurs in the passage from a customary society to a legal society, the transformation is more than a simple technical adjustment: It changes behaviors and therefore the meaning of the items of knowledge constructed in the new frame are also changed.

My observations also show with relative clarity that the proposed situations, and hence the meaning of the behaviors and productions of the students, are very sensitive to what could be identified as the custom of the class in which these situations are introduced. I had not envisioned such a central role for custom a priori.

In class E the rules for debate had been explicitly adopted. The students would state propositions that would be written on the chalkboard in order to prove or refute them; if a statement was proposed it was supposed to be sufficiently general and interesting; if something was given as proof, it should be recognized as convincing; it was not improper for somebody to stick to the position of the minority if unconvinced; etc. (See Capponi, 1985, for the characterization of the general principles of this organization.) Even though these rules permit the regulation of social interaction, the rules themselves are a source of difficulty for implementing of a genuine situation of proof. In particular, a debate in which the proponents can contradict each other is possible and to a large extent legitimate by the explicit obligation to convince, but this, together with the legality of holding a solitary position regarding what is true, opens up the possibility of refusing to be convinced. The spelling out of the rules has the possible (and sometimes essential) consequence of causing the emergence of a juridical void: In this case, the absence of rules that would oblige one to admit to having been convinced.

Moreover, this legislation does not operate unless it is kept under vigilance: Laws make judges necessary. To satisfy the law might mean in the first place to satisfy the judge. In this case, the existence of explicit rules, even though envisioning a “scientific” way of working, could provoke a drift toward the production of proofs or arguments according to their capacity to satisfy the teacher instead of the intrinsic requirements of the problem of validity. And this could occur in spite of the injunctions to autonomy, since “the class” is not able to decide by itself on the conformity of its own behaviors with the rules that have been decreed. The class is not able to bypass the double role of the teacher as mediator and arbiter.

In any class, the teacher is always and completely engaged in the situation; in this way, as Brousseau (1984) remarks, the teacher is and remains accountable (p. 4). I have observed that students may hold positions that are very different with respect to the validity of the property being



addressed: There are those that know it already, those that reject it, those that doubt about it, those that would be willing to adopt the opinion of the majority, those that are not interested. In opposition to a group of students that hold the view that the sum of the angles of a triangle is invariant, another group of students could claim that there exists a particular case that does not verify the property, even if they are not able to show which case that is. But this problématique of proof and refutation cannot develop if a very small minority holds one of the two positions: They must be defended in a sufficiently balanced way so that an authentic dialectic of validation will occur.<sup>22</sup> For this to occur, the teacher is responsible for encouraging the supporters of each position equally.

The “truth” thus becomes problematic not because the teacher does not take a position, but because the teacher shows to be ready to support or provide a status both to the thesis and the antithesis. The teacher provides a certain status to uncertainty and at the same time underscores how relevant it would be “to know.” This ensures that the statement at stake is not just a mere speculation but a conjecture. But this role for the teacher can not be assumed by the teacher unless “the class” accepts it. The students know that the teacher knows the answer, as usual, but the negotiated contract allows the teacher to retreat from his usual responsibilities of imparting knowledge. However, at the end of this contract, everyone will recover his or her position in relation to knowledge; the process of institutionalization will indicate this has occurred. The class, and the teacher with it, will return to ordinary custom until the next contract needs to be negotiated so as to let new knowings be put at work.

As a product of practices, custom evolves with those practices. Custom is modified as long as learning progresses and new mathematical practices appear. Some customary rules will become obsolete during the school year, but also, and more radically, the negotiation of the didactical contract against the custom can create ruptures that boost the meaning of a knowing by uncovering certain rules and their relation to knowledge. The model of the contract and the custom provides a framework for describing and explaining both, the dynamic character of social interactions in class inasmuch as they are related to knowledge, and the stability and permanence of those social interactions that are indispensable for the functioning of the didactic system.

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## Notes

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<sup>2</sup> The editorial notes (EN) provide additional references and clarification of the usage of certain terms for the English-speaking audience. Translation notes (TN) are included as well. Otherwise, the structure and content of the original paper has been kept as it was in 1988. It is expected that forthcoming pieces in English will further clarify some conceptual aspects of the notions of contract and custom that are alluded here. Many thanks to David Pimm, Jack Smith, and most especially to Janet Barnett for useful conceptual and editorial comments on a previous draft of the translation.

<sup>3</sup> *Didactique of mathematics* is the “science of the communication of [mathematical] knowings and their transformations: an experimental epistemology that aims at theorizing the production and circulation of knowledge in a similar way as economics studies the production and distribution of material goods” (Brousseau, 1990, p. 260, Herbst’s translation). To avoid the unfortunate associations with the English pejorative adjective *didactic*, the original French noun *didactique* is adopted as a neologism. (EN)

<sup>4</sup> *Knowing* is hereafter used as a noun to translate the French *connaissance*, whereas *knowledge* is reserved to translate the French *savoir*. *Knowings* are the results of the cognitive adaptation of a subject to a milieu. The interaction provides for the situated nature of the knowings—in terms of contextualization, personalization, and temporalization (see Herbst, 1998, pp. 34-38). Balacheff, Cooper, Sutherland, and Warfield (in Brousseau, 1997) say that “[knowings] refer to intellectual cognitive constructs, more often than not unconscious; [knowledge] refers to socially shared and recognized cognitive constructs, which must be made explicit” (p. 72). (TN)

<sup>5</sup> To bypass fashionable ideological disputes about *acquisition* and *mathematics*, it is hereafter assumed that mathematics education as a social project at least demands the students’ acquisition of mathematics—understood in a broad sense as the practices and discourse historically developed by working mathematicians. (EN)

<sup>6</sup> An *item of knowledge* is the chosen translation for the French (*un*) *savoir*, and its plural, *items*, for (*des*) *savoirs*. *Knowledge* is used to translate (*le*) *savoir*. (TN)

<sup>7</sup> The didactical functioning of the class is the functioning of the class as a system whose goal is for the teacher to transmit and for the students to acquire some culturally recognizable items of knowledge. (EN)

<sup>8</sup> See Brousseau (1997). (EN)

<sup>9</sup> See also Balacheff (1988b). (EN)

<sup>10</sup> An adidactical situation is one in which the student is enabled to use some knowings to solve a problem “without appealing to didactical reasoning [and] in the absence of any intentional direction [from the teacher].” (Brousseau, 1997, p. 30; see also Kieran, 1998). (EN)

<sup>11</sup> The notion of *devolution* is taken from Brousseau (1997) to mean “the act by which the teacher makes the student accept the responsibility for an (adidactical) learning situation or for a problem, and accepts the consequences of this transfer of this responsibility” (p. 230). (EN)

<sup>12</sup> The classroom community is the community engaged in debating the common system of validation against which a given explanation will be compared to decide whether this explanation counts as proof. “We call *proof* an explanation accepted by a given community at a given moment of time. The decision to accept it can be the object of a debate whose principal objective is to determine a common system of validation for the speakers” (Balacheff, 1987, p. 147, Herbst’s translation). (EN)

<sup>13</sup> The notion of theorem-in-action is taken from Vergnaud’s (1996) theory of conceptual fields. “A theorem-in-action is a proposition that is held to be true by the individual subject for a certain range of the situation variables (...). The scope of validity of a theorem-in-action can be different from the real theorem (...). A theorem-in-action can be false.” (p. 225). (EN)

<sup>14</sup> See also Balacheff (1990). (EN)

<sup>15</sup> The histogram is neither an instrument for the correction of actual individual measures nor a way to produce a correct measure by aggregation of those individual measures. Rather, the practice of producing a histogram is a condition that permits all independent (individual) measuring practices to be associated into a single practice (that of measuring the same triangle), hence enabling the emergence of the problematic character of such measuring. (EN)

<sup>16</sup> See Brousseau (1997) pp. 65-66. (EN)

<sup>17</sup> For an explanation of *intellectual* proofs in contrast with *pragmatic* proofs see Balacheff (1987, 1988b). (EN)

<sup>18</sup> Recall that the class must pose the problem. This open question could create the opportunity for the problem to be posed at this point. (EN)

<sup>19</sup> *Proof* is the chosen English translation for the French *preuve* and corresponds to the acceptance of an explanation by a community (see note 15). Balacheff (1987) addresses the distinction between proofs (Fr. *preuves*) and mathematical proofs (Fr. *démonstrations*) as follows: “Within the mathematical community, only those explanations that adopt a particular form can be accepted as proof. They are sequences of statements organized according to determined rules: A statement is either known to be true or deduced from those that precede it using a rule of deduction from a set of well-defined rules. We call these sorts of proofs *mathematical proofs*” (p. 148). (EN)

<sup>20</sup> The didactical contract is the “system of reciprocal obligations [between teacher and student that] resembles a contract [and] which is specific to the ‘content’, the target mathematical knowledge.” (Brousseau, 1997, pp. 31-32). (EN)

<sup>21</sup> The emergence of a norm is a rational hypothesis that, insofar as it entails that actual measurements would be “corrected toward 180°,” helps the researcher understand why, in fact, the announcement of 231° would be deemed amusing by the students and why the bets on 180° would increase. (EN)

<sup>22</sup> See Brousseau (1997) pp. 69-72. (EN)